

Advanced Space Power Systems (ASPS): High Specific Energy Li-ion Battery Cells Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)



ABSTRACT

The goal of this project element is to increase the specific energy of Li-ion battery cells to 265 Wh/kg and the energy density to 500 Wh/L at 10oC while maintaining safe operating margins. These goals will be demonstrated in large format commercial-grade cells to demonstrate the ability to scale-up the complex cell components under development in the laboratory.

ANTICIPATED BENEFITS

To NASA funded missions:

Extended EVA time (to 8 hours)

DETAILED DESCRIPTION

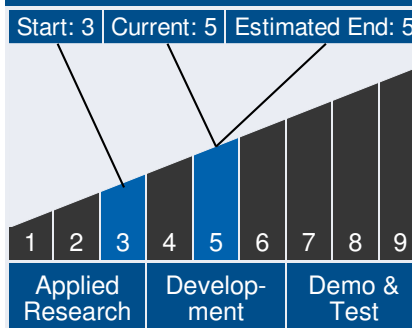
The objective of the High Specific Energy Battery project element is to develop high specific energy battery technologies that enable new capabilities for future human space exploration and scientific missions. Several mission concepts require the large amounts of energy storage of and on-demand supply of high of power. Development of low-cost high-energy storage capabilities can fulfill the strategic goals for NASA, by developing radical, high-payoff technologies, and enabling missions otherwise cost and energy-prohibitive. The availability of abundant battery power will expand the capabilities of every human mission, including future missions to asteroids, planets, moons, libration points, and orbiting structures. Furthermore, abundant battery power provides benefits for all phases of spaceflight: vehicle operations, electric propulsion systems, and destination applications. The high specific energy battery technology included within this project element has been selected to fill technical gaps identified by NASA as critical for human exploration. Batteries have been identified as being critically important for a variety of elements and missions being studied by NASA's Human Spaceflight Architecture Team (HAT), and address needs described in the Office of the Chief



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Technology Maturity



Management Team

Program Executive:

- Ryan Stephan

Program Manager:

- Stephen Gaddis

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Technologist's Space Technology Roadmaps specifically: Space Power and Energy Storage Technologies (TA-03). The technology development within this project element aims to provide the best combination of reliable and power for low mass, volume and /or cost, with safe operation within human systems a paramount objective. The main focus of the project element will be to develop space qualified batteries that exceed key performance parameters for exceeding specific energy goals of > 200 Wh/Kg and energy density goals of > 460 W/liter at the cell level. Meeting and/or exceeding these key performance parameters will allow for extending current EVAs (Extra Vehicular Activities) missions by an hour (Typical EVA's performed on ISS normally do not exceed 5 hours in duration.), while reducing EVA battery mass by 20%. At the conclusion of this project element critical battery sub-system technologies, currently at TRL 2/3 (i.e. battery cell level) will be demonstrated at TRL 4/5 by the end of FY14, while establishing novel components that when integrated into a battery assembly have the capability provide approximately 7-hours of continuous power for EVA's.

Management Team (cont.)

Project Manager:

- John Lytle

Principal Investigator:

- Charles Taylor

Technology Areas

Primary Technology Area:

Human Health, Life Support, and Habitation Systems (TA 6)

- └ Extravehicular Activity Systems (TA 6.2)
 - └ Power, Avionics, and Software (TA 6.2.3)
 - └ Battery Package (TA 6.2.3.1)

Additional Technology Areas:

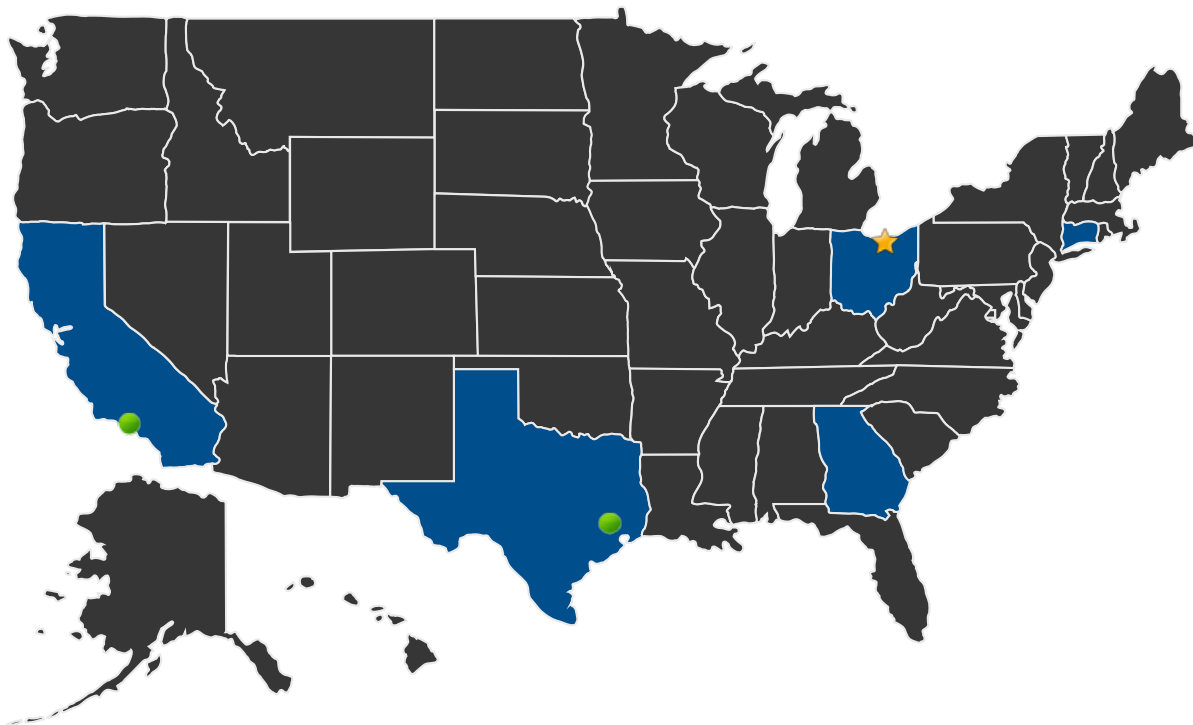
Space Power and Energy Storage (TA 3)

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U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States With Work

★ **Lead Center:**
Glenn Research Center

● **Supporting Centers:**

- Jet Propulsion Laboratory
- Johnson Space Center

DETAILS FOR TECHNOLOGY 1

Technology Title

Advanced Space Power Systems: High Specific Energy Li-ion Battery Cells

Technology Description

This technology is categorized as a hardware component or part for transportation applications

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- a. The goals will be achieved through the development and integration of high capacity silicon anodes, energetic high voltage nickel-manganese-cobalt cathodes and flame retardant electrolytes using triphenyl phosphate additives. Various coatings, additives and morphologies will be tested on these material compositions to achieve the performance, safety and cycle life required.

Capabilities Provided

- Commercial-grade high energy cells (210 Wh/kg, 500 Wh/L)
- Scale-up to large format cells (>10 Ah)
- Cycle life > 100 cycles
- Abuse tested for safety

Potential Applications

EVA advanced spacesuit